

## CLAIMS

I claim:

1. A method for processing a policy-lookup for network protection by  
5 employing a policy table comprising a plurality of policy-table entries PTE(ip),  
where  $ip = 1, 2, 3, \dots, N$  and  $N$  is a positive integer representing a total number of said  
PTE(ip), with each PTE(ip) comprising data for defining a plurality of destination  
address ranges between a first destination address DA1(ip) and a second destination  
10 address DA2(ip), a source address ranges between a first source address SA1(ip)  
and second source address SA2(ip), a destination port group ranging between a first  
destination port DP1(ip) and second destination port DP2(ip) and a source port  
group ranging between a first source port SP1(ip) and a second source port SP2(ip),  
said method comprising steps of:  
15 generating an array of destination address segments by arranging  
ranges represented by  $\{DA1(ip), DA2(ip)\}$ , for  $ip = 1, 2, 3, \dots, N$ ,  
according to a destination address sequential order thus generating a  
plurality of destination address segments S1(Idas) between first  
destination address A11(Idas) and second destination address  
20 A12(Idas) where Idas is a series of destination address sequence  
number (DASN) and  $Idas = 1, 2, 3, \dots, IIdas$ , and  $IIdas$  is a positive  
integer less than or equal to  $2N-1$ ;  
generating an array of source address segments by arranging ranges  
25 represented by  $\{SA1(ip), SA2(ip)\}$ , for  $ip = 1, 2, 3, \dots, N$ , according to  
a source address sequential order thus generating a plurality of  
source address segments S2(Isas) between a first source address  
A21(Isas) and a second source address A22(Isas), where Isas is a  
series of source address sequence number (SASN) and  $Isas = 1, 2,$   
30  $3, \dots, IIsas$ , and  $IIsas$  is a positive integer less than or equal to  $2N-1$ ;

forming a source-destination address mapping table (SDAMT) comprising a plurality of SDAMT table entries  $SDA(Isas, Idas)$  with  $Isas=1, 2, 3, \dots, IIsas$ , and  $Idas=1, 2, 3, \dots, IIdas$  and  $SD(Isas, Idas)=ip1$  wherein  $ip1$  is a policy-table entry counter of a first policy table entry wherein said  $S2(Isas)$  is included a range defined by  $SA1(ip1)$  and  $SA2(ip1)$ , and said  $S1(Idas)$  is included in a range defined by  $DA1(ip1)$ ,  $DA2(ip1)$ ;

generating an array of destination port segments by arranging ranges represented by  $\{DP1(ip), DP2(ip)\}$ , for  $ip=1, 2, 3, \dots, N$ , according to a destination address sequential order thus generating a plurality of destination address segments  $P1(Idps)$  between a first destination port  $P11(Idps)$  and a second destination port  $P12(Idps)$ , where  $Idps$  is a series of destination port sequence number (DPSN) and  $Idps=1, 2, 3, \dots, IIdps$ , and  $IIdps$  is a positive integer less than or equal to  $2N-1$ ;

generating an array of source port segments by arranging ranges represented by  $\{SP1(ip), SP2(ip)\}$ , for  $ip=1, 2, 3, \dots, N$ , according to a source address sequential order thus generating a plurality of source address segments  $S2(Isps)$  between a first source port  $P21(Isps)$  and a second source port  $P22(Isps)$ , where  $Isps$  is a series of source address sequence number (SPSN) and  $Isps=1, 2, 3, \dots, IIsps$ , and  $IIsps$  is a positive integer less than or equal to  $2N-1$ ; and

forming a source-destination port mapping table (SDPMT) comprising a plurality of SDPMT table entries  $SDP(Isps, Idps)$  with  $Isps=1, 2, 3, \dots, IIsps$ , and  $Idps=1, 2, 3, \dots, IIdps$  and  $SDP(Isps, Idps)=ip2$  wherein  $ip2$  is a policy-table entry counter of a first policy table entry wherein said  $S2(Isps)$  is included a range defined by  $SP1(ip2)$  and  $SP2(ip2)$ , and said  $S2(Idps)$  is included in a range defined by  $DP1(ip2)$ ,  $DP2(ip2)$ .

2. The method of claim 1 further comprising steps of:

forming a policy mapping table by generating a policy-mapping table entry  $PMT(ip, ip)$  for  $ip = 1, 2, 3, \dots, N$ , wherein  $PMT(ip3, ip4) = ip$  for  $ip = 1, 2, 3, \dots, N$  and  $ip3 = ip1(R1)$ , and  $ip4 = ip2(R2)$ , and  $ip1(R1)$  representing all policy-table entry counters in said SDAMT within a two-dimensional range defined by  $\{SA1(ip), SA2(ip)\}$  and  $\{DA1(ip), DA2(ip)\}$ , and  $ip2(R2)$  representing all policy-table entry counters in said SDPMT within a two-dimensional range defined by  $\{SP1(ip), SP2(ip)\}$  and  $\{DP1(ip), DP2(ip)\}$ .

3. The method of claim 1 further comprising steps of:

forming a destination address binary tree by generating an array of tree elements each having a root destination-address and two branch destination addresses and recursively each root destination address is further assigned as a next level root destination address for generating two next-level branch destination addresses wherein a first root address is  $A11(R1)$  where  $R1 = N/2$  if  $N$  is an even number and  $R1$  is  $(N+1)/2$  if  $N$  is an odd number, and said two branch destination addresses are  $A12(R1-1)$  and  $A12(R1)$ ;

forming a source address binary tree by generating an array of tree elements each having a root source-address and two branch destination addresses and recursively each root destination address is further assigned as a next level root destination address for generating two next-level branch destination addresses wherein a first root address is  $A21(R1)$  and said two branch destination addresses are  $A22(R1-1)$  and  $A22(R1)$ ;

forming a destination port binary tree by generating an array of tree elements each having a root destination-port and two branch destination ports and recursively each root destination port is further assigned as a next level root destination port for generating two next-level branch destination port wherein a first root address is P11(R1) and said two branch destination ports are P12(R1-1) and P12(R1); and

forming a source port binary tree by generating an array of tree elements each having a root source-port and two branch source ports and recursively each root source port is further assigned as a next level root source port for generating two next-level branch source port wherein a first root address is P21(R1) and said two branch destination ports are P22(R1-1) and P22(R1).

4. The method of claim 3 further comprising steps of:

receiving an incoming packet containing data for parsing a designated destination and source addresses represented by DDA and DSA respectively, and a designated destination and source ports represented by DDP and DSP respectively; and

searching along said destination address binary tree for determining a destination address root DAR and a destination address branch DAB wherein  $DAB < DDA < DAR$  and determining a destination address sequence number DASN(DDA) for said DDA;

searching along said source address binary tree for determining a source address root SAR and a source address branch SAB wherein  $SAB < DSA < DAR$  and determining a source address sequence number SASN(DSA) for said DSA;

searching along said destination port binary tree for determining a destination port root DPR and a destination port branch DPB wherein  $DPB < DDP < DPR$  and determining a destination port sequence number DPSN(DDP) for said DDP;

searching along said source port binary tree for determining a source port root SPR and a source port branch SPB wherein SPB<DSP<DPR and determining a source port sequence number SPSN(DSP) for said DSP; and

5

applying said DASN(DDA), SASN(DSA), DPSN(DDP), and SPSN(DSP) for search said SDAMT, SDPMT, and PMT for finding a policy table entry counter ip for receiving said incoming packet only when a policy-table entry counter ip is found from said PMT.

10

5. A method for processing a policy table comprising a plurality of policy-table entries with each entry comprising data for defining a plurality of destination address ranges, a source address ranges, a destination port group and a source port group, said method comprising steps of:

15

assigning an ordered sequence number as a policy-table entry counter ip to each of said policy table entries;

20

fragmenting said destination address ranges and said source address ranges listed in said policy table entries into a plurality of a sequentially-ordered destination address segments and source address segments respectively and each segment is assigned with a sequential segment number thus generating a set of source address sequence numbers (SASN) and a set of destination address sequence numbers (DASN);

25

forming a source-destination address mapping table (SDAMT) comprising a plurality of SDAMT table entries for each pair of SASN and DASN wherein each of said SDAMT table entries is provided with a policy-table entry counter ip corresponding to a first policy table entry wherein said SASN and DASN being listed;

30

fragmenting said destination port groups and said source port groups listed in said policy table entries into a plurality of a sequentially-ordered destination port segments and source port segments respectively and each segment is assigned with a sequential segment number thus generating a set of source port sequence numbers (SPSN) and a set of destination port sequence numbers (DPSN); and

forming a source-destination port mapping table (SDPMT) comprising a plurality of SDPMT table entries for each pair of SPSN and DPSN wherein each of said SDPMT table entries is provided with a policy-table entry counter ip corresponding to a first policy table entry wherein said SPSN and DPSN being listed.

6. A method for processing a table comprising a plurality of table entries with each entry defined data for defining a plurality of multiple-dimensional spaces, said method comprising steps of:

assigning an ordered sequence number as a table entry counter ip to each of said table entries;

fragmenting said multiple-dimensional spaces into order spatial ranges and assigned each of said spatial ranges with a sequential spatial range-numbers;

forming multiple-dimensional range-spaces by employing said sequential spatial range-numbers as coordinates and assigning an associated table entry counter ip to each block defined by said spatial range-number coordinates for providing an index for correlating each of said sequential spatial range-numbers to said each of said table entry.

7. The method of claim 6 further comprising steps of:

forming a multiple dimensional table-entry counter space defined by table-entry counters as coordinates wherein a spatial space defined by said coordinates and pointed by a combination of all of said associated table entry counter ipc entered into each of said multiple-dimensional range spaces associated with said counter ip is entered with a value of a table entry counter ip.

5

10

8. A database for use in processing a table wherein said table including a plurality of table entries each assigned with an ordered table entry counter ip and each entry defined data for defining a plurality of multiple-dimensional spaces, said database comprising:

15

an array of ordered spatial ranges each assigned with an ordered spatial range number generated from fragmenting said multiple-dimensional spaces into said array of order spatial ranges;

20

a multiple-dimensional table generated from forming a plurality of multiple-dimensional range-spaces by employing said sequential spatial range-numbers as coordinates and assigning an associated table entry counter ip to each block defined by said spatial range-number coordinates for providing an index for correlating each of said sequential spatial range-numbers to said each of said table entry.

25